*DESCRIPTIVE ANALYSIS OF EATING REGULATION IN
OBESE AND NONOBESE CHILDREN*

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Bite rate, sip rate, and concurrent activities of six 7-yr-old children, three obese and three nonobese, were observed at lunchtime over a six-month period. A procedure for decreasing bite rate, putting eating utensils down between bites, was implemented in a multiple-baseline across-subjects design. Sip rates and concurrent activities were observed to assess behavioral covariations. In addition, bite rate and amount of food completed were computed over six food categories to analyze food preferences. Results indicated the control of bite rate across all subjects, with a significant reduction in amount of food consumed. Correlations between the response classes indicated they were at least partially independent. Differences in eating behavior of obese and nonobese subjects were observed for breadstuffs and milk drinking.

DESCRIPTORS: obesity, eating, reinforcer, praise, instructions, behavioral covariation, food preference, mealtime behavior, children

A substantial amount of research has been conducted on behavioral control of adult obesity (see reviews by Abramson, 1973; Hall and Hall, 1974), but research on control of childhood obesity has been minimal (Stimbert and Coffey, 1972). This lack of research is disappointing, as a substantial proportion of obese children will become obese adults (Mobbs, 1970) and suffer the resultant negative social and physical side effects. In addition, Salans (1974) indicated that obesity present at an early age results in an increase in adipose cell number, as opposed to an increase in adipose cell size if obesity develops in adulthood. This has important implications for treatment, as cell size, not number, may decrease as a function of weight loss. Thus, early onset obesity may be more resistant to treatment than obesity that begins in adulthood. Research on childhood obesity could be useful for several reasons, including identification of high-risk children for prevention purposes and development of techniques of behavior change

suited to obese children. Also, research on childhood obesity may provide useful information for the control of adult obesity.

Obesity may be classified as either a regulatory or metabolic disorder (Wright, 1962). In the first case, food intake and/or exercise are not properly regulated; in the second case, metabolic factors, including neurological, hormonal, and enzymatic influences are important. Behavioral procedures are primarily designed to influence obesity caused by regulatory problems. There is evidence that regulatory disturbances are present at an early age: Nisbett and Gurwitz (1970) indicated variables that influence eating in heavy infants are similar to those influencing eating in the obese adult.

Regulatory disturbances of food intake may be a function of eating behaviors and/or selection of foods. Obese persons may eat more often, and more at each sitting than nonobese persons, or they may prefer foods with high calorie values. In addition, their eating style may be considerably different than that of the nonobese. This latter point was documented by Gaul, Craighead, and Mahoney (1976), who observed differences in bite rate, sip rate, and consummatory behaviors for obese and nonobese sub-

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jects eating the standard fare in a fast-food hamburger restaurant. However, Hill and McCutcheon (1975) did not find consistent differences in laboratory eating behaviors of obese and nonobese subjects, and both Hill and McCutcheon (1975) and Myer and Pudel (1972) found no differences in the amount of food consumed by obese and nonobese subjects. The potential importance of changing eating habits in the control of obesity was stressed by Stuart and Davis (1972), and Mahoney (1974) who demonstrated greater weight modification by focusing on eating behaviors rather than on procedures focusing on weight loss. While experiments to identify differences in eating behaviors of adults are limited (Mahoney, 1975), at present there have been no investigations comparing the eating behaviors of obese and nonobese children in the natural environment.

The present study measured several eating behaviors of obese and nonobese children during lunchtime in a nonlaboratory setting. Measurement was performed over approximately six months to study eating patterns over an extended time period in the presence of varied foods. In addition, a procedure suggested for controlling adult eating—putting eating utensils down between bites—was implemented to assess its effect on eating rate. Changes in eating rate could demonstrate the utility of this procedure, and provide an assessment of food preference. That is, if eating rate is decreased, it may be assumed that a subject is more likely to choose highly preferred foods, and neglect less preferred foods. In addition to measuring eating behaviors, milk drinking and concurrent activities were measured to identify any relationships among table behaviors that might be important for modification. Wahler (1975) indicated the importance of multiple measurement in descriptive analyses of behavior to identify behavioral covariations or side effects. For example, an inverse relationship between eating behavior and concurrent activities may indicate that increasing concurrent activities would be useful for the control of eating in children.

METHOD

Subjects

Three male and three female 7-yr old elementary school children were randomly chosen from a sample of 30 children whose parents consented to their participation in a study involving measurement of eating behaviors. Three of the subjects were obese according to the 20% overweight criterion (Mobbs, 1970), with heights, weights, and sex of 51.5 in., 90 lb, female; 54.5 in., 99 lb, female; and 53.5 in., 98 lb, male. The heights, weights, and sex of the three nonobese were 46.5 in., 38.5 lb, male; 50.5 in., 64 lb, female; and 48.5 in., 44.5 lb, male.

Measurement

Children were observed over a six-month period, from November through April, on approximately two occasions per week. Observations could occur on Monday, Wednesday, or Friday. Subjects were observed in the school lunchroom during their scheduled lunch period. Observation extended from the time the subject seated himself with his lunchtray until the lunchtray was returned, with observation times ranging from 3 min, 20 sec to 17 min, 10 sec. The six subjects were observed by two trained observers, with each observer primarily responsible for measurement of three children. The seating of subjects in the lunchroom was not arranged. Observers attempted to maintain sufficient distance to reduce reactivity of measurement and observe all subjects. The children were habituated to the observers during a two-week period in which reliability of the measurement procedure was established before formal data collection. The trained observers recorded the behaviors defined below in successive 10-sec intervals. A portable tape recorder was used to present the observation intervals. The responses were not mutually exclusive, *i.e.*, all responses could be recorded in the same interval. The four response definitions and recording procedures were as follows: (1) *Bites*: insertion of

eating utensil and food into mouth and withdrawal of utensil from mouth, or insertion of entire piece or portion of food into mouth (as with finger foods) and withdrawal of same or removal of fingers. Also, contact of mouth or tongue to food stuffs (as with ice cream). Daily food items that appeared on the subject's lunch tray were recorded on score sheets. Frequency of bites was marked during each 10-sec interval under the appropriate food items. (2) *Sips*: contact of drinking utensil (cup, glass, straw, etc.) to lips and removal of same from lips. The only beverage recorded for all subjects was milk. Frequency of sips of this beverage was recorded in each 10-sec interval. (3) *Concurrent activities*: any activity that occurred during the period and competed with eating, such as talking, laughing, throwing objects, and other body movements as turning more than 90 degrees in the chair, when not eating, scratching with "eating hand", and getting out of seat. In no instances were these activities observed to occur when the subject was eating. This response category was scored on an occurrence, nonoccurrence basis for each 10-sec interval. (4) *Utensils down*: placing utensil on the lunch tray or table after each bite of food requiring a utensil and removing hands from utensil. The occurrence of this response was recorded during the Instructions and Instructions and Praise experimental conditions. Per cent of compliance was computed by comparing frequency of utensils down with total frequency of bites for which utensil was used.

Nutritional assessment. To assess nutritional intake across experimental conditions, bite rates and per cent of each food completed in quarters were computed for each food item for each session. Sip rates of milk were also computed each session. Amount of milk completed could not be measured, as many children drank milk from standard opaque cartons, and the amount left could not be observed. Rates were derived by dividing number of bites or sips by the number of minutes within an observation session. Each food item was grouped into one of seven basic food categories: breads, milk, vegetables, fruit,

meats and high protein entrees (spaghetti, chili, lasagna, tacos), sandwiches, and desserts and miscellaneous, as potato chips, corn chips, snack foods. It should be noted that when sandwiches were available at lunch, they served as the major source of protein. Food items were placed in these categories for a nutritional analysis of food intake, as each group contained foods similar in nutritive and caloric value.

Reliability. Measurement reliability was assessed on a minimum of five occasions for each subject, with a maximum of eight. Reliability checks for all children were distributed across the conditions, with at least one check per phase. During reliability assessment, the three subjects of one primary observer were observed by the second observer. Per cent agreement was calculated by dividing the number of intervals in which both observers agreed on occurrences by the total number of intervals in which either observer scored an occurrence. Thus, nonoccurrence intervals were excluded from this analysis. Mean per cent agreement was 80 for bites, 84 for sips, 76 for concurrent activities, and 81 for utensils down, with respective ranges of 73 to 87, 72 to 91, 68 to 85, and 69 to 100.

Experimental Conditions

Baseline. No special contingencies were arranged during lunch. This phase assessed possible differences in natural eating behaviors and behavioral covariations between the obese and nonobese subjects.

Instructions. Instructions designed to modify eating rate were implemented to examine procedures for modifying eating behavior. Each subject was individually told that he was a participant in an experiment to examine the ability of children to slow down their rate of eating. Subjects were instructed to place their utensils on the table or tray after every bite. Before entering the lunch line each session they were individually reminded to continue to practise the utensils-down response.

Instructions and praise. The procedures employed during the Instructions phase were con-

tinued and praise for compliance was added. This was done to increase compliance to instructions for several children, and also to maintain initial effects of instructions, which are often transitory (Ayllon and Azrin, 1964). This condition also provided an assessment of any differential effects of praise on obese and non-obese children. Praise consisted of the observer's social approval, such as "You put your fork down more times than usual, that's good", following each meal that per cent of compliance was greater than it had been during the instructions-only phase.

Experimental Design

Baseline measurement was begun at the same time for each subject, and the second phase, instructions to put fork down was implemented sequentially across all six subjects in a multiple-baseline fashion. The choice of when to implement the instructions was made in a random fashion, independent of whether the subjects were obese or nonobese. Subjects 1, 5, and 6 were obese and 2, 3, and 4 nonobese. The second experimental condition, instructions plus praise, was begun after inspection of compliance during instructions. These data indicated that compliance was either decreasing or not being maintained at high, stable rates. The instructions-plus-praise condition was designed to maintain or increase the effectiveness of instructional control, and not as a separate treatment to be compared to instructions alone. Hence, baseline eating rates were not recovered by withdrawing instructions before implementing the instructions-plus-praise condition.

RESULTS

Treatment Effects

Figure 1 presents the bite rate per minute for each child, with mean rates in each condition represented by the horizontal dotted lines. The bite rates were relatively stable or increasing for each subject during baseline measurement, except for a possible decreasing trend for S-4. The

sequential implementation of instructions to put fork down after each bite decreased bite rate for each subject. The rates for four of the six subjects continued to decrease when praise was added. The rates during praise were maintained for a fifth subject (S-5), but increased to above baseline levels for the sixth subject (S-4). Also, the addition of praise to the instructions condition increased average compliance for each subject, with percentage compliance in instructions and instructions-plus-praise conditions for each child as follows: S-1, 53 to 94; S-2, 21 to 50; S-3, 88 to 100; S-4, 44 to 49; S-5, 91 to 96; S-6, 77 to 100. The compliance data indicated the obese subjects (S-1, 5, 6) were more compliant to instructions ($X = 74\%$) than the nonobese ($X = 51\%$), and per cent compliance as a function of praise was greater for the obese subjects ($X = 97\%$) than nonobese subjects ($X = 66\%$).

Changes in bite rate, sip rate, and concurrent activities were assessed by a three-factor, repeated measures on two factors analysis of variance. The between factor was obese, non-obese; the within factors were Phase (baseline, instructions, instruction + praise) and Response (bite rate, sip rate, concurrent activities). The dependent variable in each case was the mean for the data points of that response collected in each phase. The analysis indicated a significant Phase [$F(2,8) = 2.7, p < 0.001$] and Response [$F(2,8) = 36.09, p < 0.001$] effect, as well as a significant Phase $\times$ Response interaction [$F(6,16) = 8.13, p < 0.01$], which is presented in Figure 2. *Post hoc* F tests for simple effects conducted for each response indicated a significant ($p < 0.05$) reduction in bite rate and concurrent activities as a function of instruction and praise. While the changes were not significant, the graph does indicate that bite rate continued to decrease over time, while concurrent activities did not. However, sip rates remained stable throughout, independent of changes in the other two responses.

The effect of a reduction in bite on amount of food eaten was also assessed. The mean percent-

Fig. 1. Bite rate across baseline, instructions, and instructions-plus-praise conditions for each subject. The mean rate during each condition is represented by a dotted line. Subjects 1, 5, and 6 were obese, Subjects 2, 3, and 4 nonobese.

Fig. 2. Mean bite rate, sip rate, and percentage of intervals in which concurrent activities occurred for all subjects across baseline, instructions, and instructions-plus-praise conditions.

age of food eaten by each subject in each phase was transformed by an arc-sin transformation and analyzed by a treatment by subjects analysis of variance, with baseline, instructions, and instructions + praise the treatments. This analysis indicated a significant treatment effect [$F(2,10) = 5.51, p < 0.05$], with *post hoc* analysis indicating this effect was due to the per cent completed during instructions + praise ($X = 61$) being less than the per cent completed in baseline ($X = 82$) and instructions ($X = 75$).

Food Preference

Food preference was evaluated by first calculating the proportion of total bites and sips of each type of food for each subject during the baseline and combined treatment phases. The proportions were then analyzed by a three-factor, repeated measures on two factors analysis of variance, with food type and phase the within

factors, and Groups (obese/nonobese) the between factor. This analysis indicated significant Food [$F(6,20) = 2.82, p < 0.05$], Food $\times$ Group [$F(6,24) = 2.51, p < 0.05$], and Food $\times$ Phase interactions [$F(6,24) = 4.10, p < 0.01$]. *Post hoc* t-tests for the significant Food $\times$ Group interaction indicated that obese subjects preferred milk and the nonobese preferred bread. The means for the groups over each food group are presented in Figure 3. Similar analyses for the Food $\times$ Phase interaction showed only a decrease in preference for desserts by both groups when the rate was suppressed.

Behavioral Covariation

Covariations between response classes were further analyzed by computing Pearson-Product moment correlation coefficients for data points in baseline and combined treatment conditions. The treatment conditions were combined in this

Fig. 3. Mean proportion of total bites and sips emitted to various food groups for obese and nonobese subjects.

analysis to provide an approximately equal number of data points in the baseline and treatment conditions, and because the data in the two treatment conditions were very similar. The results of these calculations are presented in Table 1.

The most consistent finding in the relationship between bite rate and sip rate is that during baseline, a positive correlation was observed for each of the obese subjects, while a negative correlation was shown for the nonobese subjects.

Thus, bite and sip rate covaried together for obese but not for nonobese subjects. These differences are probably due in part to the higher sip rates emitted by the obese subjects. No consistent changes in the degree of correlation were observed from baseline to treatment.

The most consistent finding in the analysis of covariation between response classes was between bite rate and concurrent activities for the obese subjects. There was a marked decrease in

Table 1
Individual correlations between response categories during baseline and treatment conditions.

S#	Baseline			Treatment		
	Bite Rate Sip Rate	Bite Rate Con. Act.	Sip Rate Con. Act.	Bite Rate Sip Rate	Bite Rate Con. Act.	Sip Rate Con. Act.
OBESE						
1	0.14	0.46	0.06	0.31	-0.09	-0.52
5	0.28	0.00	0.29	-0.74	-0.50	0.88
6	0.46	0.04	-0.65	0.25	-0.35	-0.02
NONOBESE						
2	-0.37	-0.33	0.05	-0.11	-0.60	-0.31
3	-0.56	-0.63	0.16	-0.32	0.16	0.22
4	-0.34	0.44	-0.70	-0.65	0.25	0.10

covariation from baseline to treatment for the obese subjects, but data were not consistent across nonobese subjects. Two nonobese subjects displayed a slight decrease in covariation, with one showing an increase in degree of covariation. As previously indicated, both bite rate and concurrent activities decreased during treatment, but the decrease in covariation observed for the obese subjects may have been due to the interaction between the differential change in bite rate and concurrent activities observed for the obese than nonobese subjects.

No consistent pattern was observable between sip rate and concurrent activities.

Post Measurements

Heights and weights of each child were obtained at the end of the experiment. Post weights are necessary to ensure that subjects remained within their relative obese and nonobese groups throughout the experiment. Though the experimental procedures did reliably reduce the amount of food eaten, they were designed to permit a descriptive analysis of eating behavior, and were probably not implemented at a sufficient frequency to produce large-scale weight changes. The initial and final height and weight measurements were 51.5 to 51.5 in., 90 to 96.5 lb, S-1; 54.5 to 57.5 in., 99 to 107.5 lb, S-5; 53.5 to 54.5 in., 98 to 97 lb, S-6, for the obese subjects, and 46.5 to 46.5 in., 38.5 to 42 lb, S-2; 50.5 to 51.5 in., 64 to 64 lb, S-3; 48.5 to 49 in., 44.5 to 46.5 lb, S-4, for the nonobese. These data indicated that subjects remained within the relative obese, nonobese categories.

DISCUSSION

The results indicated that eating rate decreased for both obese and nonobese children as a function of the relatively simple procedures of instructions to place eating utensils down between bites, and instructions combined with praise for compliance. Regulation of food consumption was effected by these procedures, with a significant change in bite rate and amount

consumed. These data support the use of procedures that directly modify eating behavior that may improve regulation control. In addition, the results demonstrate that a previously untested component of many adult weight-control programs, putting eating utensils down between bites, actually can be easily managed, and does decrease food intake.

The covariations between the various response classes were not consistent in the baseline and treatment conditions. Bite rate was reliably affected as a function of treatment, but sip rate remained stable, indicating bite rate and sip rate are relatively independent response classes. This finding indicates that if a child is obese because of difficulty regulating high-caloric liquid intake he may not benefit from a program designed to change solid food eating. The concurrent-activities response class decreased when bite rate decreased. This decrease in bite rate and concurrent activities was apparent during Phase 2. However, the bite rate continued to decrease in Phase 3, but concurrent activities increased slightly. Thus, a predicted inverse relationship between decrease in eating behaviors and increase in concurrent activities was not apparent.

The obese and nonobese subjects were distinguishable by differences in eating behavior of breadstuffs and in drinking milk. The obese subjects drank more milk and the nonobese subjects ate more bread. The reliability of these differences is notable, considering the multiple measurement of each subject in which he was presented numerous types of food, and the small sample size. Differences have to be large and consistent in order to be significant under these conditions. It is interesting that total bite rate across all food groups was not significantly different. Thus, the differences in general bite rate between obese and nonobese adults observed by Gaul *et al.* (1975) were not evident, which is consistent with results reported by Hill and McCutcheon (1975). This difference may in part be due to the fact that Gaul *et al.* (1975) observed subjects eating the same foods on one occasion, while in the Hill and McCutcheon and

the present study, eating behavior was observed for many foods over several occasions. Thus, the differences in eating behaviors observed may partly have been a function of procedural variations. The difference in sip rates of children is similar to a recent finding that lunch-time drinking behaviors of obese and nonobese female adults were significantly different (Adams, Stunkard, Ferguson, and Agras, Note 1).

In summary, bite rate was shown to be an easily modifiable response, and reduction in bite rate was associated with a decrease in total food consumption. Also, there were consistent differences in consummatory behavior of obese and nonobese subjects for milk drinking and eating breadstuffs. Finally, the procedure of multiple measurement of eating behaviors across various food groups was recommended to establish differences between the obese and nonobese subjects.

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